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Effect of organic nutrition on chemical and biological properties of red loam soils under baby corn (*Zea mays* L) cultivation

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ABSTRACT

A field experiment was conducted at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala to find out the effect of organic nutrition on chemical and biological properties of the red loam soils under baby corn cultivation. Treatments comprised different sources of organic nutrition such as vermicompost, coirpith compost and poultry manure along with in situ green manuring and biofertilizer (PGPR mix I) application. In the control treatment inorganic fertilizers (NPK 135:65:45 kg/ha) were applied. Poultry manure application along with in situ green manuring recorded higher available N content in soil after the experiment while poultry manure with application of PGPR mix I recorded higher available P content. The available potassium content of soil was higher when vermicompost was applied along with PGPR mix I. Application of organic manures together with biofertilizer (PGPR mix I) resulted in enhanced microbial activity in the soil.

Keywords: Baby corn; vermicompost; poultry manure; PGPR mix I

INTRODUCTION

Organic farming is a holistic way of farming and it is one of the several approaches suggested to meet the objective of sustainable agriculture (Rajamani 2018). Organic sources have become an established means for restoring soil health through enhanced microbial activity in the soil and the benefits on soil chemical and biological properties vary considerably with the organic sources. Organic farming is done to release nutrients to the crops for increased sustainable production in an eco-friendly and pollution-free environment. It aims to produce crop with a high nutritional value.

Organically produced crops have more demand compared to conventional crops and baby corn being a high value crop, quality is important than quantity and hence integration of organic and biofertilizers assumes significance. With this background the present study was aimed at finding out the effects of organic nutrition practices on chemical and biological properties of the soil under baby corn cultivation.

MATERIAL and METHODS

The study consisted of a field experiment which was conducted at the instructional farm of the College of Agriculture, Vellayani, Thiruvananthapuram, Kerala. The experiment was laid out in randomized block design with ten treatments replicated thrice. The treatments were T_1: Vermicompost, T_2: Coirpith compost, T_3: Poultry manure, T_4: In situ green manuring with cowpea + vermicompost, T_5: In situ green manuring with cowpea + coirpith compost, T_6: In situ green manuring with cowpea + poultry manure, T_7: Vermicompost + PGPR mix I, T_8: Coirpith compost + PGPR mix I, T_9: Poultry manure with PGPR mix I and T_{10}: NPK 135:65:45 kg/ha (control) as inorganic fertilizers. The organic sources were applied as basal on nitrogen equivalent basis (NPK 135:65:45 kg/ha) (Mavarkar 2016). In case of control treatment, N and K were applied in 2 split doses, half as basal and remaining half at 25 DAS and full quantity of P was given as basal.

For in situ green manuring, cowpea was raised in the field and incorporated at 50 per cent flowering stage. Baby corn was sown two weeks after the incorporation of cowpea. PGPR mix I was applied as seed treatment (treating the moistened seeds with PGPR @ 30 g per kg seed) followed by soil application @ 110 g/m^2 (mixture of dry cow dung and PGPR mix I in 50-1 ratio) at sowing and 15 DAS. Nutrient content of organic manures was evaluated (Table 1).

Observations were made on available N, P, K and microbial count in the soil after the experiment. Available N content of soil samples was analysed using alkaline permanganate method suggested by Subbiah and Asija (1956). Available K content was estimated by extracting the soil sample with neutral normal ammonium acetate and estimated using flame photometer (Jackson 1973). Available P content of soil sample was analysed using alkaline permanganate method suggested by Subbiah and Asija (1956).

Population of microbes (bacteria, fungi, actinomycetes, azospirillum and phosphobacteria) in the soil was estimated using serial dilution technique. Soil samples from different treatments were taken and sieved in a 2 mm mesh. One gram of the soil was suspended in 90 ml sterilized water and serial dilutions of the suspensions were prepared by further dilutions. The dilution and plating were done aseptically in a laminar air flow chamber (Herbert 1990).

RESULTS and DISCUSSION

The organic nutrition treatments significantly influenced chemical and biological properties of the soil. The nutrient content of the soil and microbial count were enhanced by the organic nutrition practices.

There was a general increase in the available nitrogen status and decrease in the available phosphorus and potassium in the soil after the experiment (Table 2). The in situ green manuring of cowpea along with poultry manure application (T_6) recorded the highest available nitrogen content (397.15 kg/ha) in soil which was on par with T_4 (380.43 kg/ha) and T_3 (376.78 kg/ha). The treatment T_9 (application of poultry manure and PGPR mix I) recorded the highest available phosphorus content (68.80 kg/ha) after the experiment. The highest available potassium content in soil (212.50 kg/ha) was recorded with the treatment T_7 (application of vermicompost and PGPR mix I) which was on par with T_4 (193.30 kg/ha) in which in situ green manuring along with vermicompost application was done. Poultry manure had a moderately higher nitrogen and phosphorus content (Table 1).

The mineralization pattern of poultry manure has indicated that nearly 60 per cent of the nitrogen in the manure is present as uric acid which quickly changes to ammoniacal form (Smith 1950). When green manuring has preceded the poultry manure application it would have further added more nitrogen to the soil through decomposition of proteinous substances in the legume enriching the available nitrogen in the soil. The favourable effect of PGPR on rhizosphere modification and increased phosphatase activity (Gunes et al 2015) would have resulted in enhanced available P content in the soil. The vermicompost is rich in potassium and its application along with PGPR would have released more plant available potassium to the soil since the PGPR is a consortium of microorganisms including the K solubilizing bacteria to supply all the major nutrients.

The treatments with biofertilizer (PGPR mix I) recorded higher microbial count in the soil compared to other treatments (Table 3). Higher count of bacteria (83 x 10^7 CFU/g soil) and *Azospirillum* (11.14 x 10^5 CFU/g soil) was recorded in the treatment where poultry manure with PGPR mix I was applied. When vermicompost was applied along with PGPR mix I, it recorded the higher fungal (29.67 x 10^5 CFU/g soil) and phosphobacterial population (37.67 x 10^3 CFU/g soil) after the experiment.

PGPR mix I is a consortium of component cultures viz *Azospirillum lipoferum*, *Azotobacter chrococcoum*, *Bacillus megaterium* and *B sporothermodurans* for supplementing the major nutrients as reported by Gopi et al (2020). Pujiastuti et al (2018) reported that the application of poultry manure has several benefits including the soil organic matter enrichment. The soil organic matter serves as a source food for the microorganisms in the soil.

Uz and Tavali (2014) in their study also suggested that vermicompost is an excellent source of organic matter and supports higher microbial population and its diversity. These manures along with the application of PGPR mix I, which modifies the mineral status of the crop rhizosphere through the secretion of amino acids, organic acids and other compounds might have stimulated the microbial activity of the soil which is evident from the results of the

Table 1. Nutrient content of organic manures and green manure applied

Organic source	Nutrient content (%)		
	N	P	K
Vermicompost	1.31	1.21	1.55
Poultry manure	1.87	1.08	2.04
Coir pith compost	1.10	0.05	1.01
Green manure cowpea	2.30	0.09	1.90

T_1: Vermicompost, T_2: Coirpith compost, T_3: Poultry manure, T_4: In situ green manuring with cowpea + vermicompost, T_5: In situ green manuring with cowpea + coirpith compost, T_6: In situ green manuring with cowpea + poultry manure, T_7: Vermicompost + PGPR mix I, T_8: Coirpith compost + PGPR mix I, T_9: Poultry manure with PGPR mix I and T_{10}: NPK 135:65:45 kg/ha (control)

Table 2. Effect of organic nutrition on chemical properties of soil

Treatment	pH	EC (dS/m)	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
T_1	5.53	0.117	1.050	271.79	61.83	181.95
T_2	5.62	0.130	1.027	258.34	61.87	162.80
T_3	5.60	0.130	1.200	376.78	61.37	154.33
T_4	5.71	0.127	1.013	380.43	63.57	193.30
T_5	5.83	0.130	1.180	355.87	64.40	164.44
T_6	5.82	0.117	1.063	397.15	61.97	162.93
T_7	5.74	0.110	1.147	263.42	65.23	212.50
T_8	5.41	0.123	1.327	355.41	61.90	168.81
T_9	5.60	0.120	1.013	359.66	68.80	167.74
T_{10}	5.80	0.130	1.320	267.60	58.47	155.90
SEm±	0.008	0.007	0.020	7.17	0.79	10.19
$CD_{0.05}$	NS	NS	NS	21.440	2.362	30.500
Initial status	5.21	0.260	1.02	268.06	86.21	223.56

T_1: Vermicompost, T_2: Coirpith compost, T_3: Poultry manure, T_4: In situ green manuring with cowpea + vermicompost, T_5: In situ green manuring with cowpea + coirpith compost, T_6: In situ green manuring with cowpea + poultry manure, T_7: Vermicompost + PGPR mix I, T_8: Coirpith compost + PGPR mix I, T_9: Poultry manure with PGPR mix I and T_{10}: NPK 135:65:45 kg/ha (control)

Table 3. Effect of organic nutrition on microbial count in the soil

Treatment	Microbial count (CFU/g of soil)				
	Bacteria (10^7)	Fungi (10^5)	Actinomycetes (10^4)	*Azospirillum* (10^5)	Phosphobacteria (10^3)
T_1	49.64	16.73	22.67	2.17	15.67
T_2	46.00	17.33	26.86	1.34	13.66
T_3	49.12	19.96	23.68	1.66	12.00
T_4	56.67	20.33	22.69	2.64	12.33
T_5	47.64	24.33	23.66	1.35	14.67
T_6	49.66	22.32	24.56	1.66	11.33
T_7	80.00	29.67	24.00	10.56	37.67
T_8	79.46	20.23	26.00	8.46	29.67
T_9	83.00	19.72	27.79	11.14	32.00
T_{10}	30.00	14.26	19.67	0.67	1.67
SEm±	4.54	0.27	0.05	0.64	1.66
$CD_{0.05}$	1.182	0.649	NS	1.910	4.971

T_1: Vermicompost, T_2: Coirpith compost, T_3: Poultry manure, T_4: In situ green manuring with cowpea + vermicompost, T_5: In situ green manuring with cowpea + coirpith compost, T_6: In situ green manuring with cowpea + poultry manure, T_7: Vermicompost + PGPR mix I, T_8: Coirpith compost + PGPR mix I, T_9: Poultry manure with PGPR mix I and T_{10}: NPK 135:65:45 kg/ha (control) present study. There was a drastic reduction in the microbial population in case of control treatment wherein nutrients were applied through inorganic fertilizers. This may be due to the suppressing effect of fertilizer source on the microbial community as suggested by Staley et al (2018) who reported decreased microbial diversity in agricultural soils amended with urea. The present study revealed that the application of organic manures (vermicompost, coir pith compost and poultry manure) with other organic sources (in situ green manuring with cowpea and PGPR mix I) enhanced the chemical and biological properties of the soil through the improved soil nutrient content and microbial activity.

REFERENCES

Gopi GK Meenakumari KS, Anith KN, Nysanth NS and Subha P 2020. Application of liquid formulation of a mixture of plant growth promoting rihizobacteria helps reduce the use of chemical fertilizer in amaranthus (*Amaranthus tricolor* L). Rhizosphere **15:** 100212, doi: 10.1016/j.rhisph.2020.100212.

Gunes A, Karagoz KT, Turan M, Kotan R, Yildirim E, Cakmakci R and Sahin F 2015. Fertilizer efficiency of some plant growth promoting rhizobacteria for plant growth. Research Journal of Soil Biology **7(2):** 28-45.

Herbert RA 1990. Methods of enumerating microorganisms and determining biomass in natural environments. In: Methods in microbiology (R Grigorova and JR Norris eds) Vol 22, Academic Press, London, pp 344-404.

Jackson ML 1973 Soil chemical analysis. 2nd edn, Prentice Hall of India Pvt Ltd, New Delhi, India, 498p.

Mavarker V 2016. Nutrient scheduling for baby corn (*Zea mays* L) intercropped in coconut garden. MSc (Agric) Thesis, Kerala Agricultural University, Thrissur, Kerala, India.

Pujiastuti ES, Tarigan JR, Sianturi E and Ginting BB 2018. The effect of chicken manure and beneficial microorganisms of EM-4 on growth and yield of kale (*Brassica oleracea acephala*) grown on andisol. International Conference on Agribusiness, Food and Agro-technology Medan, Indonesia, 19-21 September 2018, IOP Conference Series: Earth and Environmental Science **205(1):** 012020, doi: 10.1088/1755-1315/205/1/012020.

Rajamani A 2018. Sustainable agriculture through organic farming in India. Multidisciplinary Global Journal of Academic Research **5(3):** 27-34.

Smith R 1950. Poultry mnaure- a fertilizer. Poultry Digest **9:** 550-551.

Staley C, Breuillin-Sessoms F, Wang P, Kaiser T, Ventera RT and Sadowsky MJ 2018. Urea amendment decreases microbial diversity and selects for specific nitrifying strains in eight contrasting agricultural soils. Frontiers in Microbiology **9:** 634, doi: 10.3389/fmicb.2018.00634.

Subbiah BV and Asija GL 1956. A rapid procedure for the determination of available nitrogen in soil. Current Science **25:** 259-260.

Uz I and Tavali IE 2014. Short-term effect of vermicompost application on biological properties of an alkaline soil with high lime content from Mediterranean region of Turkey. Scientific World Journal **14:** doi: 10.1155/2014/395282.